

MEMORANDA AND INDEX OF CULTURES OF UREDINEAE, 1899-1917¹

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The cultures of the rusts, which were conducted under the auspices of the Purdue University Agricultural Experiment Station, and extended over a period of nineteen years, had a small beginning. For the first three years only such time was given to the work as the writer could spare from his duties as head of the Botanical Department of the Station and as Professor of Vegetable Physiology and Pathology in Purdue University. In most of the following years an assistant was especially employed during two or so months each spring, who had entire charge of the testing of spore viability, sowing of the spores, and care of the inoculated plants, the chief part of the culture work being done during May and June. The position was held by fourteen individuals, selected with the needs of the work especially in view, and ranging from a junior high school student to university instructors, who without exception showed superior ability in conducting the work. Financial support was provided by a grant from the Botanical Society of America in 1903, 1906 and 1907, and by coöperation with the Bureau of Plant Industry of the U. S. Department of Agriculture in 1904 and 1905. In the other years it was supplied by the Purdue University Agricultural Experiment Station, and from 1908 onward the work was made a part of the rust project under the Adams fund.

During the progress of the work the writer, usually accompanied by an associate, made many shorter or longer excursions for securing data and material. These field observations were directed toward detecting the juxtaposition of spore-forms that might be supposed to have genetic connection, as well as toward securing suitable culture material. The fruitfulness of this method is apparent from the fact that during the extended study

¹ Contribution from the Botanical Department of the Purdue University Agricultural Experiment Station.

of heteroecious species only three times was a discovery of alternate hosts effected that was not the outcome of a previous field observation. In two of these cases, that of *Uromyces acuminatus* (more properly *U. Steironematis*, see page 76,* Jour. Myc. 12: 25), and *Puccinia Ceanothi* (see page 196,* Mycologia 4: 27) sowings were made on all available hosts in the greenhouse, recorded as bearing aecia, and in the case of *P. fraxinata* (*P. peridermiospora*, see page 8,* Bot. Gazette 29: 275), a morphological similarity was detected between aesciospores and urediniospores, leading to successful cultures.

Beginning with the immediate vicinity of Lafayette, Indiana, the range of observations was extended to various parts of the state, and in the ninth year of the work, 1907, to other states. This year a trip was made to the foothills of Colorado, which was repeated in 1908, 1911 and 1916, observations being made from Boulder to Trinidad, and once westward to Ouray and Durango. Between 1908 and 1916 trips were made northward to Wisconsin and Michigan, eastward to Maine and Pennsylvania, to South Carolina, Alabama and Mississippi in the south, and to Texas, New Mexico and Arizona in the southwest. So far as possible places were selected where there were local collectors, or where records showed that species requiring investigation had at some time been secured. The chief collecting grounds of Ellis in New Jersey, Ravenel in North and South Carolina, Atkinson and Underwood in Alabama, and Kellerman in Kansas were visited, and the collecting grounds of Schweinitz at Salem, North Carolina, and Bethlehem, Pennsylvania, would have been visited, if opportunity had favored. In this way many obscure names in the literature were connected with living material on which fresh and more extended studies, often including cultures, could be carried out. By this method the attention given to the genus *Gymnosporangium* was made to expand our limited knowledge of a few species into an understanding of the life history of some two dozen species and of their alternate hosts. The effectiveness of the work with *Gymnosporangium* was greatly enhanced by the special interest in it taken by my asso-

* For explanation of these page numbers see p. 246 at beginning of the index.

ciate, Dr. F. D. Kern, who for ten years took part in the culture work. The grass and sedge rusts were, however, the ones that received the most extended and prolonged attention.

To carry on the work more than 2140 collections with resting spores were available, together with over 250 collections with spores not requiring a resting period. Tests of all of these, and of some many times repeated, showed that not all were viable, at least at the time tested, and therefore not serviceable. This material was provided in part by those directly connected with the work, and to a considerable extent by more than 85 botanical correspondents, many of whom contributed most generously in material and field observations year after year. Altogether about 3750 sowings, that is, attempts at cultures were made, of which about one in seven resulted in successful infection of the host. These tests were almost wholly made in a greenhouse, although a few were conducted in the open field when small plants suitable for placing in pots were not available.

It is difficult to say just how many species have been grown through some part of their life cycle during the nineteen-year period, owing to the constant shifting of accepted names as knowledge regarding them accumulated. Probably the list includes about one hundred species, as they are now rated, or nearly twice as many as they would at first have been listed, and of this number about eight were heteroecious to one autoecious. Of the heteroecious species some twenty were verifications of combinations previously established, mostly by European investigators, while about sixty-five provided alternate hosts for species whose life cycle was before unknown, most of these being grass and sedge forms not known outside of North America.

When viewing the present location of the New York Botanical Garden many years ago, it then being a rolling meadow without buildings of any kind, my companion, Professor L. M. Underwood, remarked that some day I might be called upon to supply the rust portion for the projected North American Flora, and added that if I did so he had no doubt that I would greatly reduce the number of species. The culture studies have enabled me to do this, but not quite in the way Professor Underwood

and others at that time had in mind. In many cases the first results have been to increase the number of species. Thus *Puccinia alternans* and *P. obliterata* were described as new species as result of cultures, but as the studies proceeded were reduced to synonyms of the long recognized *P. Agropyri*, together with *Aecidium Aquilegiae*, *A. Clematidis*, *Puccinia tomipara*, *P. Paniculariae*, and some others. But on the whole, as the cultures have largely dealt with heteroecious species, there has been a reduction in names as the alternate forms were brought together, and sometimes by the recognition as races of forms that were once thought distinct species.

The nomenclature of the reports has been made as conservative as possible, in order to give them reasonable uniformity. The new generic names proposed by the writer in 1906 at the Vienna Congress scarcely find an echo in them, while on the other hand the terminology for spore-forms, brought out in 1905, was put into use in the second report following, and proved highly serviceable.

In the various reports of the cultures, and as a result of them, the following thirteen specific names were transferred to other genera: *Aecidium magnatum* Arth. and *A. Silphii* Sydow to *Uromyces*, *Aecidium Ceanothi* Peck, *A. Impatientis* Schw., *A. Jamesianum* Peck, *A. macrosporum* Peck, *A. monoicum* Peck, *A. Pammelii* Trel., *A. Phrymae* Halst., *A. pustulata* Curt., *A. Sambuci* Schw. to *Puccinia*, and *Puccinia tumidipes* Peck and *P. Vernoniae* Berk. & Curt. to *Bullaria*.

Also as the result of the cultures the following sixteen species were described as new: *Gymnosporangium corniculans* Kern, *G. exterum* Arth. & Kern, *G. trachysorum* Kern, and on the authority of the writer *Puccinia albiperidia*, *P. alternans*, *P. Caricis-Asteris*, *P. Caricis-Erigerontis*, *P. Caricis-Solidaginis*, *P. Eatoniae*, *P. Koeleriae*, *P. obliterata*, *P. patruelis*, *P. universalis*, *Uromyces effusus*, *U. Solidagini-Caricis*, and *U. Steironematis*, but as the result of further studies most of these were subsequently buried in synonymy.

CORRECTIONS

In making corrections the consecutive page numbers used are those explained below at the beginning of the index, while the original pages are given in parentheses. A few of the corrections are typographical errors, or slips of the pen, but many are necessitated by information variously acquired after the reports were written and printed. Evident and inconsequential errors are not included. To save space the following abbreviations are used in the parentheses: B.G. for Botanical Gazette, J.M. for Journal of Mycology, and My. for Mycologia, and are followed by the original volume and page number.

Pages 5, 9 (B.G. 29: 272, 276), under 7 and 3 respectively, for "Americana Lagh." and "Americana," read *Andropogonis* Schw. and *Andropogonis*, respectively, and for "Andropogi Schw." and "Andropogi," read *Ellisiana* Thüm. and *Ellisiana*, respectively.

Pages 7, 9, 22, 28 (B.G. 29: 274, 276; 35: 16, 22), for "K. & S.," read E. & K.

Pages 8, 31, 51, 60, 67, 75, 76, 77, 78, 83, 103, 106, 114, 127, 146, 156, 160, 164, 174 (B.G. 29: 275; J.M. 10: 9; 11: 57, 66; 12: 16, 24, 25, 26, 27; 13: 192; 14: 14, 17, 25; My. 1: 236, 255; 2: 221, 225, 229, 239), for the species of *Spartina*, given as "cynosuroides" or "cynosuroides Willd.," read *Michauxiana* or *Michauxiana* Hitchc. The two species of grass were for a time confused and one name used for both.

Pages 11, 65, 77, 86, 94 (J.M. 8: 52; 12: 14, 26; 13: 196, 204), for a species of *Carex*, for "tetanica" and "tetanica Schk.," read *blanda* and *blanda* Dewey, respectively.

Pages 17, 45, 49, 50, 60 (B.G. 35: 11; J.M. 11: 51, 55, 56, 66), for the species of *Lepidium*, given as "apetalum" and "apetalum Willd.," read *densiflorum* and *densiflorum* Schrad., respectively.

Page 26 (B.G. 35: 20), the *Aecidium* mentioned under 5. P. AMPHIGENA was subsequently found not to be *A. Smilacis* Schw.

Pages 41, 42 (J.M. 10: 19, 20). The supposed infection in 1903 of *Bromus ciliatus* by the application of aeciospores from *Dirca palustris* was the most serious error that occurred in the nineteen years of culture work. The grass used for the culture was undoubtedly infected before the sowing was made, as explained on pages 56 and 57 of the report following. The combination of aecia and telia under the name "*Puccinia hydnoidea*," was unwarranted. The *Aecidium hydnoideum* was under close observation during the whole culture period, and there were a score of attempts to find the alternate host, but even to the present writing no progress has been made.

Pages 49, 50 (J.M. 11: 55, 56), under no. 4, for the species of *Sophia* from Nebraska, given as "incisa (Engelm.) Greene," read *intermedia* Rydb.

Pages 49, 60, 68, 77 (J.M. 11: 55, 66; 12: 17, 26), for the species of *Sophia* from Indiana used in the cultures, given as "incisa" and "incisa (Engelm.) Greene," read *brachycarpa* and *brachycarpa* Rydb.

Pages 51, 60, 67, 77, 103, 114, 127, 146, 160, 174, (J.M. 11: 57, 66; 12: 16, 26; 14: 14, 25; My. 1: 236, 255; 2: 225, 239), after *Puccinia fraxinata*, for "Schw.," read Link.

Page 62, first line of reprint, for "1," read 12.

Page 64 (J.M. 12: 13), under no. 6, for "Schw.," read Desmaz.

Pages 66, 77 (J.M. 12: 15, 26), under no. 7, for specific name "aquatilis" and "aquatilis Wahl.," read *nebraskensis* and *nebraskensis* Dewey. On page 66 the comparison of the large, thick-walled urediniospores (common on this host, the form being known as *Puccinia Garretii* Arth.) to the amphispores of *P. Caricis-stictae* was an error. It may be pointed out here that the same mistake regarding name of the host also occurs in Sydow, *Uredineen 2115*, Barth. *Fungi Columb. 2351* and *3838*. *Carex nebraskensis* is a very common sedge about Denver and Boulder, Colo., while *C. aquatilis* is rare or possibly absent.

Pages 85, 92, 94 (J.M. 13: 195, 202, 204), under *Lactuca*, for "virosa," read *scariola*.

Pages 93, 95, 107, 114, 130, 146, 195, 201 (J.M. 13: 203, 205; 14: 18, 25; My. 1: 239, 255; 4: 26, 32), under *Gymnosporangium*, for "Nelsoni Arth.," read *juvenescens* Kern, and also delete the last sentence under no. 19 on page 107 (J.M. 14: 18). *Gymnosporangium Nelsoni* and *G. juvenescens* were for a time confused. Both produce aecia on *Amelanchier* and *Sorbus*, but the former gives rise to woody galls, often very small, while the latter is foliicolous.

Page 96, first line of the reprint for "1907," read 1908.

Pages 100, 180 (J.M. 14: 11; My. 4: 11), under *Puccinia*, for "montanensis Ellis," read *Agropyri* Ellis & Ev., as pointed out on page 263 (My. 8: 139).

Pages 109, 115 (J.M. 14: 20, 26), under no. 2, for "Cryptandri Ellis & Barth.," read *substerilis* Ellis & Ev., and for "*Sporobolus cryptandrus* (Torr.) A. Gray," read *Stipa viridula* Trin.

Pages 112, 115 (J.M. 14: 23, 26), under no. 6, for "mutabilis Ellis & Gall.," read *Blasdalei* Diet. & Holw., for "reticulatum Fraser," read *Brandegei* S. Wats., and for "recurvatum Rydb.," read *cernuum* Roth.

Page 123 (My. 1: 232), under no. 11, for "*Aster arenarioides* D. C. Eaton," read *Erigeron arenarioides* A. Gray.

Pages 129, 130, 146 (My. 1: 238, 239, 255), the small form of *Gymnosporangium* on *Juniperus virginiana*, which gave rise to pycnia and aecia on *Crataegus punctata*, should have been referred to *G. floriforme* Thaxter.

Page 133 (My. 1: 242), delete the entire paragraph beginning "The aecia of this species," etc., except the first sentence.

Page 147 (My. 1: 256), under no. 8, for "glomerata," read *mexicana* (L.).

Page 173 (My. 2: 238), under no. 1, change the reading thus: Teliospores on *Carex lanuginosa* Michx., sown on *Onagra biennis* (L.) Scop., and on *C. trichocarpa* Muhl. sown on *Gaura biennis* L.

Pages 178, 180 (My. 4: 9, 11), 19th and 6th line from bottom respectively, for "Douglasii," read *spartioides*.

Pages 180, 189, 197, 200, 231 (My. 4: 11, 20, 28, 31; 7: 72), as a species of *Senecio*, for "lugens" or "lugens A. Gray," read *spartioides* or *spartioides* T. & G., respectively.

Pages 197, 202 (My. 4: 28, 33), under no. 2, the material in hand from Isle au Haut, Me., was *Puc. quadriporula* (*P. Grossulariae*), but the results of infection were obtained from stray spores of *Uromyces perigynius*, as explained at page 235 (My. 7: 76) in the report of cultures for 1912.

Pages 256, 265 (My. 8: 132, 141), under no. 4, for "Agropyri E. & Ev. (*P. alternans* Arth.)," read Cockerelliana Bethel. This distinctive species was not recognized, and had not been named until long after the cultures were made.

Pages 257, 265, (My. 8: 133, 141), under no. 5, for "Anchusa officinalis," read *Lycopsis arvensis*.

Pages 261, 263, 265 (My. 8: 137, 139, 141), under no. 3, for "montanensis Ellis" and "montanensis," read apocrypta Ellis & Tracy and apocrypta, respectively. On page 262 three species are confused. *Puccinia apocrypta* is not a synonym of *P. Agropyri*. The characters given for *P. apocrypta* are those of the true *P. montanensis*, for which the type is the collection cited.

Pages 274, 275 (My. 9: 302, 303), under no. 2, for "B. & C." read Schw.

SUMMARY OF CULTURES

In order to give a clearer perspective of the work, and to make the data more readily available, the following tabulation is given of the heteroecious species that were successfully grown on alternate hosts. Autoecious species, and heteroecious species grown from urediniospores or amphispores only, have not been included. The years are those in which successful cultures were carried out. Only such synonymy is given as will account for the names used at different times in the reports. The page numbers are those explained below at the beginning of the index. Pages in broad faced type indicate the host from which spores were taken for culture, while pages in common type indicate the host on which the culture was successfully established.

Year	Rust	Telial host	Aecial host
1904 1905	<i>Puc. Sorghi</i> Schw.	<i>Zea Mays</i> 59, 68	<i>Oxalis corniculata</i> (<i>O. cymosa</i>) 59, 68
1909	<i>Puc. Ceanothi</i> (E. & K.) Arth.	<i>Andropogon Hallii</i> 168	<i>Ceanothus americana</i> 168
1912	<i>Puc. Ellisiana</i> Thüm.	<i>Andropogon</i> sp. 230	<i>Viola cucullata</i> 230 <i>V. Nuttallii</i> 230
1899 1903 1906 1910	<i>Puc. Andropogonis</i> Schw. (<i>P. americana</i> Lagerh.)	<i>Andropogon scoparius</i> 5, 6, 33, 87, 186 <i>A. virginicus</i> 186	<i>Pentstemon hirsutus</i> (<i>P. pubescens</i>) 5, 6, 33, 87, 186 <i>P. alpinus</i> 186
1903 1905 1910	<i>Puc. pustulata</i> (Curt.) Arth.	<i>Andropogon furcatus</i> 39, 67, 186 <i>A. scoparius</i> 39	<i>Comandra umbellata</i> 39, 67, 186
1904 1905 1907	<i>Puc. Pammelii</i> (Trel.) Arth. (<i>P. Panici</i> Diet.)	<i>Panicum virgatum</i> 50, 67, 105	<i>Euphorbia corollata</i> 50, 67 <i>E. marginata</i> 105
1901 1904 1905 1906 1907 1909 1910 1916	<i>Puc. poculiformis</i> (Jacq.) Wettst. (<i>P. graminis</i> Pers.)	<i>Agropyron pseudorepens</i> 162 <i>A. repens</i> 51 <i>A. Smithii</i> 270 <i>A. tenerum</i> 51, 105, 187 <i>Agrostis alba</i> 68, 88, 187 <i>Avena sativa</i> 105 <i>Cinna arundinacea</i> 12 <i>Elymus canadensis</i> 51, 88, 270 <i>Hordeum vulgare</i> 88 <i>Sitanion longifolium</i> 162, 187 <i>Sporobolus cryptandrus</i> 270 <i>Triticum aestivum</i> (<i>T. vulgare</i>) 88, 162	<i>Berberis vulgaris</i> 12, 51, 68, 88, 105, 162, 187, 270
1917	<i>Puc. Majanthae</i> (Schum.) Arth.	<i>Phalaris arundinacea</i> 278	<i>Iris versicolor</i> 278
1904 1910 1912	<i>Puc. Stipae</i> Arth.	<i>Koeleria cristata</i> 189 <i>Stipa comata</i> 231 <i>S. spartea</i> 58, 188	<i>Aster ericoides</i> 58, 188 <i>A. multiflorus</i> 58, 188 <i>A. Novae-Angliae</i> 58, 188 <i>Grindelia squarrosa</i> 188 <i>Gutierrezia Sarothrae</i> 231 <i>Senecio spartioides</i> 189, 231 <i>Solidago canadensis</i> 188

Year	Rust	Telial host	Aecial host
1917	<i>Puc. Sporoboli</i> Arth.	<i>Sporobolus heterolepis</i> 280	<i>Allium cernuum</i> 280 <i>A. Nuttallii</i> 280 <i>Lilium umbellatum</i> 280
1899 1902 1904 1905	<i>Puc. verbenicola</i> (E. & K.) Arth. (<i>P. Vilfae</i> Arth. & Holw.)	<i>Sporobolus longifolius</i> 7, 22, 50, 67	<i>Verbena stricta</i> 7, 22 <i>V. urticifolia</i> 22, 50, 67
1902 1904 1905 1906 1907 1908 1909 1910 1911 1915 1916 1917	<i>Puc. subnitens</i> Diet.	<i>Distichlis spicata</i> 25, 49, 68, 87, 104, 126, 160, 188, 208, 259, 273, 278	<i>Abronia fragrans</i> 273 <i>Atriplex hastata</i> 126, 160, 208 <i>Bursa Bursa-pastoris</i> 68, 104 <i>Chenopodium album</i> 25, 87, 104, 126, 160, 188, 208, 250, 278 <i>Cleome spinosa</i> 49, 208 <i>Erysimum asperum</i> 49, 68 <i>Lepidium densiflorum</i> (<i>L. apetalum</i>) 49 <i>L. virginicum</i> 49, 68 <i>Polygonum aviculare</i> 273 <i>Sarcobatus vermiculatus</i> 87, 126 <i>Sophia brachycarpa</i> 49, 68
1908 1909 1910 1914 1916	<i>Puc. Muhlenbergiae</i> Arth. & Holw. (<i>P. tosta</i> Arth.)	<i>Muhlenbergia gracillima</i> 271 <i>M. mexicana</i> 142 <i>M. racemosa</i> (<i>M. glomerata</i>) 161, 187 <i>Schedonnardus paniculatus</i> 272 <i>Sporobolus asperifolius</i> 240, 241	<i>Callirhoe involucrata</i> 142, 161, 187 <i>Malvastrum coccineum</i> 271, 272 <i>Sphaeralcea digitata</i> 241 <i>S. incana</i> 240 <i>S. lobata</i> 241
1902 1903 1905 1907 1909 1910	<i>Puc. amphigena</i> Diet.	<i>Calamovilfa longifolia</i> 26, 33, 67, 104, 160, 187	<i>Smilax herbacea</i> 26 <i>S. hispida</i> 26, 33, 67, 104, 160, 187
1911 1912	<i>Puc. monoica</i> (Peck) Arth.	<i>Koeleria cristata</i> 234 <i>Trisetum majus</i> 213 <i>T. subspicatum</i> 213, 234	<i>Arabis</i> sp. 213, 234
1904 1910 1916	<i>Puc. Rhamni</i> (Pers.) Wettst. (<i>P. coronata</i> Corda)	<i>Agrostis</i> sp. 271 <i>Avena sativa</i> 52 <i>Calamagrostis canadensis</i> 187	<i>Rhamnus alnifolia</i> 187 <i>R. caroliniana</i> 52 <i>R. cathartica</i> 52 <i>R. lanceolata</i> 52 <i>R. Purshiana</i> 271

Year	Rust	Telial host	Aecial host
1899 1904 1905 1907 1908 1909	<i>Puc. fraxinata</i> (Link) Arth. (<i>P. peridermi- ospora</i> Arth.)	<i>Spartina Michauxiana</i> (not <i>S. cynosuroides</i>) 8, 51, 67, 103, 160 <i>S. polystachya</i> 127 <i>S. stricta</i> 127	<i>Fraxinus lanceolata</i> (<i>F. viridis</i>) 8, 51, 67, 103, 127, 160
1915 1916	<i>Puc. Distichlidis</i> E. & E. (<i>P. Kelseyi</i> Syd.)	<i>Spartina Michauxiana</i> 261, 271	<i>Steironema ciliatum</i> 261, 271
1905 1908 1910 1915	<i>Puc. Seymouriana</i> Arth.	<i>Spartina cynosuroides</i> 259 <i>S. Michauxiana</i> (not <i>S. cynosuroides</i>) 75, 127, 188, 258	<i>Apocynum cannabinum</i> 258 <i>Asclepius syriaca</i> 259 <i>Cephalanthus occident- alis</i> 75, 127, 188
1902 1910	<i>Puc. Jamesiana</i> (Peck) Arth. (<i>P. Bartholo- maei</i> Diet.)	<i>Bouteloua curtipendula</i> (<i>Atheropogon curti- pendulus</i>) 24, 188	<i>Asclepias incarnata</i> 24 <i>A. syriaca</i> 24, 188
1899 1907 1909 1911	<i>Puc. Phragmitis</i> (Schum.) Körn.	<i>Phragmites communis</i> (<i>P. Phragmites</i>) 2, 104, 160, 208	<i>Rumex crispus</i> 2, 104, 160, 208 <i>R. obtusifolius</i> 2
1902 1907	<i>Puc. simillima</i> Arth.	<i>Phragmites communis</i> (<i>P. Phragmites</i>) 26, 104	<i>Anemone canadensis</i> 26, 104
1899 1902 1904 1915	<i>Puc. Windsoriae</i> Schw.	<i>Tridens flavus</i> (<i>Triodia cuprea</i> , <i>Tricuspis ses- lerioides</i>) 6, 22, 50, 260	<i>Ptelea trifoliata</i> 6, 22, 50, 260
1903	<i>Puc. Eatoniae</i> Arth.	<i>Eatonia pennsylvanica</i> 40	<i>Ranunculus abortivus</i> 40
1908	<i>Puc. Koeleriae</i> Arth.	<i>Koeleria cristata</i> 138	<i>Mahonia Aquifolium</i> 138
1916	<i>Puc. Liatridis</i> (E. & A.) Bethel	<i>Koeleria cristata</i> 273	<i>Laciniaria punctata</i> 273
1910	<i>Puc. Crandallii</i> Pam. & Hume	<i>Festuca confinis</i> 196	<i>Symphoricarpos race- mosus</i> 196
1915	<i>Puc. Cockerelliana</i> Bethel	<i>Festuca Thurberi</i> 256	<i>Thalictrum dioicum</i> 256
1908 1915	<i>Puc. Asperifolii</i> (Pers.) Wettst.	<i>Secale cereale</i> 128, 257	<i>Lycopsis arvensis</i> 128, 257
1915	<i>Puc. apocrypta</i> Ellis & Tracy	<i>Agropyron tenerum</i> 262 <i>Elymus virginicus</i> 262	<i>Hydrophyllum capi- tatum</i> 262

Year	Rust	Telial host	Aecial host
1904	<i>Puc. Clematidis</i> (DC.)	<i>Agropyron biflorum</i> 140	<i>Anemone cylindrica</i> 232
1906	Lagerh. (<i>P. Agropyri</i>)	<i>A. pseudorepens</i> 105	<i>Aquilegia canadensis</i>
1907	E. & E., <i>P. lomipara</i>	<i>A. Smithii</i> 232	140, 161
1908	Trel., <i>P. cinerea</i> Arth.	<i>A. sp.</i> 161	<i>Clematis Drummondii</i>
1909	<i>P. alternans</i> Arth., <i>P. obliterata</i> Arth.)	<i>Bromus purgans</i> 87, 127	242
1911		<i>B. ciliatus</i> 56	<i>C. ligusticifolia</i> 232
1912		<i>B. Porteri</i> 139	<i>C. virginiana</i> 56, 87, 105,
1914		<i>Elymus canadensis</i> 232	127
		<i>E. virginicus</i> 242	<i>Oxygraphis Cymbalaria</i>
		<i>Puccinellia airoides</i> 137, 208	(<i>Ranunculus Cymbalaria</i>) 137, 208
			<i>Thalictrum alpinum</i> 161
			<i>T. dioicum</i> 139
			<i>Viorna Scottii</i> 105
1902	<i>Puc. Impatiensis</i>	<i>Elymus canadensis</i> 162	<i>Impatiens aurea</i> 25, 33,
1903	(Schw.) Arth.	<i>E. striatus</i> 161, 162	51, 161, 162
1904		<i>E. virginicus</i> 25, 33, 51,	
1909		162	
1907	<i>Puc. oblecta</i> Peck	<i>Scirpus americanus</i> 109	<i>Bidens cornata</i> 109
			<i>B. frondosa</i> 109
1890	<i>Puc. angustata</i> Peck	<i>Scirpus atrovirens</i> 6, 12,	<i>Lycopus americanus</i> 6,
1901		52, 86, 103, 186, 230	12, 52, 86, 103, 186,
1904		<i>S. cyperinus</i> 125, 208	208, 230
1906			<i>L. uniflorus</i> (<i>L. communis</i>) 125
1907			
1908			
1910			
1911			
1912			
1915	<i>Puc. Eriophori</i> Thüm.	<i>Eriophorum viridicarinatum</i> 255	<i>Senecio aureus</i> 255
1905	<i>Puc. canaliculata</i> (Schw.) Lagerh.	<i>Cyperus esculentus</i> 74	<i>Xanthium "canadense"</i> 74
1905	<i>Puc. Eleocharidis</i> Arth.	<i>Eleocharis palustris</i> 74, 87, 124	<i>Eupatorium perfoliatum</i> 74, 87, 124
1906			
1908			
1908	<i>Puc. macrospora</i> (Peck) Arth.	<i>Carex comosa</i> 134	<i>Smilax hispida</i> 134
1901	<i>Puc. Grossulariae</i>	<i>Carex arctata</i> 226, 254	<i>Ribes aureum</i> 53
1903	(Pers.) Lagerh. (<i>P. albiperidia</i> Arth.),	<i>C. blanda</i> 65, 86	<i>R. Cynosbati</i> 12, 33, 53,
1904		<i>C. crinita</i> 53, 86, 102, 226	86, 102, 182, 225, 226,
1905			237, 254
1906		<i>C. flexuosa</i> (<i>C. tenuis</i>) 182, 226, 254	<i>R. gracile</i> 65, 86
1907			<i>R. rotundifolium</i> 53, 86
1910		<i>C. gracillima</i> 33, 53	<i>R. uva-crispa</i> 33, 53
1912		<i>C. pallescens</i> 182	
1913		<i>C. pubescens</i> 12, 225	
1915		<i>C. squarrosa</i> 86	
		<i>C. sp.</i> 237	

Year	Rust	Telial host	Aecial host
1901 1902 1905 1907 1909 1910	<i>Puc. Caricis</i> (Schum.) Schroet.	<i>Carex aristata</i> 158, 186 <i>C. nebraskensis</i> 66 <i>C. riparia</i> 22, 103 <i>C. stipata</i> 66, 103 <i>C. stricta</i> 11, 22, 186	<i>Urtica gracilis</i> 11, 22, 66, 103, 158, 186
1914	<i>Puc. minutissima</i> Arth.	<i>Carex filiformis</i> 245	<i>Decodon verticillatus</i> 245
1907 1909 1910 1916	<i>Puc. universalis</i> Arth.	<i>Carex filifolia</i> 270 <i>C. stenophylla</i> 110, 159, 185	<i>Artemisia dracuncu- lodes</i> 110, 159, 185 <i>A. gnaphalodes</i> 270
1907	<i>Puc. Phrymae</i> (Halst.) Arth.	<i>Carex longirostris</i> 111	<i>Phryma leptostachya</i> 111
1901 1902 1904 1905 1907 1908 1909 1910 1912 1913 1914 1915	<i>Puc. Asterum</i> (Schw.) Kern (<i>P. extensicola</i> Plow., <i>P. Caricis-Asteris</i> Arth., <i>P. Caricis-Erigerontis</i> Arth., <i>P. Caricis-Solidaginis</i> Arth., <i>P. Dulichii</i> Syl.)	<i>Carex festiva</i> 159, 185 <i>C. festucea</i> 13, 22, 52 <i>C. foenea</i> 13, 14, 21 <i>C. Jamesii</i> 27 <i>C. retrorsa</i> 228 <i>C. rosea</i> 102 <i>C. scoparia</i> 184, 228, 229 <i>C. sparganioides</i> 66, 124 <i>C. stipata</i> 27 <i>C. sp.</i> 102 <i>C. vulpinoidea</i> 238, 240 <i>Dulichium arundinaceum</i> 240, 254	<i>Aster adscendens</i> 159, 185 <i>A. cordifolius</i> 14, 102 <i>A. paniculatus</i> 13, 14, 21, 102, 228 <i>Erigeron annuus</i> 13, 22, 52 <i>E. philadelphicus</i> 22 <i>Euthamia graminifolia</i> 184, 229 <i>Leptilon canadense</i> 22 <i>Solidago caesia</i> 27 <i>S. canadensis</i> 27, 66, 124, 238, 240, 254 <i>S. glaberrima</i> 238 <i>S. mollis</i> 238 <i>S. rigida</i> 27 <i>S. rugosa</i> 238 <i>S. serotina</i> 27 <i>S. ulmifolia</i> 27
1902 1904 1905 1906 1908 1909 1910 1911	<i>Puc. Peckii</i> (DeT.) Kellerm.	<i>Carex lanuginosa</i> 52, 66, 85, 158, 184, 208 <i>C. stipata</i> 20, 124 <i>C. trichocarpa</i> 20, 21, 52, 85, 158, 184	<i>Gaura biennis</i> 158 <i>Meriolix serrulata</i> 184 <i>Onagra biennis</i> (<i>Oenothera biennis</i>) 20, 21, 52, 66, 85, 124, 158, 184, 208
1906 1908 1910	<i>Puc. patruelis</i> Arth. (<i>P. Opizii</i> Arth. not Bubák)	<i>Carex pratensis</i> 136 <i>C. siccata</i> 185 <i>C. sp.</i> 85	<i>Agoseris glauca</i> 136 <i>Lactuca canadensis</i> 85, 185 <i>L. sativa</i> 85, 185 <i>L. virosa</i> 85

Year	Rust	Telial host	Aecial host
1901 1902 1904 1905 1906 1908	<i>Puc. Sambuci</i> (Schw.) Arth. (<i>P. Atkinsoniana</i> Diet., <i>P. Bolleyana</i> Sacc.)	<i>Carex Frankii</i> 85 <i>C. lupulina</i> 65 <i>C. lurida</i> 21, 124 <i>C. trichocarpa</i> 14, 21, 52	<i>Sambucus canadensis</i> 14, 21, 52, 65, 85, 124
1904 1905	<i>Puc. Polygoni-amphibii</i> Pers.	<i>Polygonum emersum</i> 53, 69, 53	<i>Geranium maculatum</i> 53, 69
1910	<i>Puc. argentata</i> (Schultz) Wint.	<i>Impatiens aurea</i> 189	<i>Adoxa Moschatellina</i> 189
1909	<i>Urom. Andropogonis</i> Tracy	<i>Andropogon virginicus</i> 163	<i>Viola cucullata</i> 163
1902 1917	<i>Urom. seditosus</i> Kern (<i>U. Aristidae</i> Auth. not E. & E.)	<i>Aristida basiramea</i> 279 <i>A. oligantha</i> 23	<i>Plantago aristata</i> 279 <i>P. lanceolata</i> 279 <i>P. Rugelii</i> 23
1916	<i>Urom. Sporoboli</i> E. & E.	<i>Sporobolus virginae-</i> <i>florus</i> 274	<i>Allium stellatum</i> 274
1915	<i>Urom. Hordei</i> Tracy	<i>Hordeum pusillum</i> 263	<i>Nothoscordium striatum</i> 263
1911	<i>Urom. Peckianus</i> Farl.	<i>Distichlis spicata</i> 209	<i>Atriplex hastata</i> 209
1905 1907 1909 1910 1912 1917	<i>Urom. Polemonii</i> (Peck) Barth. (<i>U. acuminatus</i> Arth., <i>U. Sparlinae</i> Farl., <i>U. Steironematis</i> Arth., <i>U. magnatus</i> Arth.)	<i>Spartina Michauxiana</i> 76, 106, 164, 198, 236, 282	<i>Collomia linearis</i> 236 <i>Polemonium reptans</i> 198 <i>Polygonatum biflorum</i> 282 <i>P. commutatum</i> 282 <i>Steironema ciliatum</i> 76, 106, 164 <i>S. lanceolatum</i> 164 <i>Vagnera stellata</i> 282
1906 1907 1908 1914	<i>Urom. Scirpi</i> (Cast.) Burr.	<i>Scirpus fluviatilis</i> 89, 106, 128, 242	<i>Cicuta maculata</i> 89, 106, 128 <i>Sium cicutaefolium</i> 242
1903 1910 1912 1914 1917	<i>Urom. perigynius</i> Halst. (<i>U. Solidagini-</i> <i>Caricis</i> Arth.)	<i>Carex deflexa</i> 190 <i>C. intumescens</i> 190, 234 <i>C. sparganioides</i> 279 <i>C. tribuloides</i> 242 <i>C. varia</i> 37	<i>Aster ericoides</i> 190 <i>A. paniculatus</i> 190, 234 <i>A. Tweedyi</i> 242 <i>Rudbeckia laciniata</i> 279 <i>Solidago caesia</i> 37 <i>S. canadensis</i> 37, 234 <i>S. flexicaulis</i> 37 <i>S. serotina</i> 37 <i>S. rugosa</i> 190

Year	Rust	Telial host	Aecial host
1910 1912	<i>Urom. Junci</i> (Desm.) Tul.	<i>Juncus balticus</i> 191, 236	<i>Ambrosia artemisiae-</i> <i>folia</i> 191 <i>A. psilostachya</i> 191 <i>A. trifida</i> 191 <i>Caudus Flodmanii</i> 191, 236
1906 1907	<i>Urom. Silphii</i> (Syd.) Arth.	<i>Juncus tenuis</i> 92, 106	<i>Silphium perfoliatum</i> 92, 106
1908	<i>Urom. houstoniatus</i> (Schw.) Sheldon	<i>Sisyrinchium gram-</i> <i>ineum</i> 129	<i>Houstonia caerulea</i> 129
1908 1911	<i>Gym. Libocedri</i> (P. Henn.) Kern	<i>Libocedrus decurrens</i> 143, 211	<i>Amelanchier vulgaris</i> 211 <i>Crataegus cerronis</i> 211 <i>C. Pringlei</i> 143 <i>C. tomentosa</i> 211
1907 1911	<i>Gym. inconspicuum</i> Kern	<i>Juniperus utahensis</i> 113, 211	<i>Amelanchier erecta</i> 113 <i>A. vulgaris</i> 211
1909	<i>Gym. exiguum</i> Kern	<i>Juniperus virginiana</i> 169	<i>Crataegus Pringlei</i> 169
1908 1910	<i>Gym. Davisii</i> Kern	<i>Juniperus sibirica</i> 132, 194	<i>Aronia arbutifolia</i> 194 <i>A. nigra</i> 132, 194
1906 1907 1908 1910	<i>Gym. juvenescens</i> Kern	<i>Juniperus scopulorum</i> 93, 107, 130 <i>J. virginiana</i> 195	<i>Amelanchier canadensis</i> 93, 107 <i>A. erecta</i> 107, 130, 195 <i>A. intermedia</i> (<i>A.</i> <i>Botryapium</i>) 107 <i>Sorbus americana</i> 93, 107, 130
1911	<i>Gym. Kernianum</i> Bethel	<i>Juniperus utahensis</i> 216	<i>Amelanchier vulgaris</i> 216
1909	<i>Gym. trachysorum</i> Kern	<i>Juniperus virginiana</i> 172	<i>Crataegus cerronis</i> 172 <i>C. coccinea</i> 172 <i>C. punctata</i> 172
1908 1914	<i>Gym. Botryapites</i> (Schw.) Kern	<i>Chamaecyparis thyooides</i> 131, 242, 243	<i>Amelanchier canadensis</i> 242, 243 <i>A. intermedia</i> 131
1907 1909 1910 1911 1914	<i>Gym. nidus-avis</i> Thax.	<i>Juniperus virginiana</i> 108, 129, 165, 194, 210, 242	<i>Amelanchier erecta</i> 210 <i>A. vulgaris</i> 194, 242 <i>Crataegus Pringlei</i> 165 <i>Cydonia vulgaris</i> 194 <i>Malus coronaria</i> 129, 210 <i>M. Malus</i> 108, 129 <i>M. ioensis</i> 165

Year	Rust	Telial host	Aecial host
1907 1908 1909 1910	<i>Gym. clavipes</i> C. & P.	<i>Juniperus sibirica</i> 107, 164, 193 <i>J. virginiana</i> 130	<i>Amelanchier erecta</i> 107, 164, 193 <i>A. intermedia</i> 107 <i>Crataegus punctata</i> 164 <i>C. tomentosa</i> 193 <i>C. sp.</i> 130
1908 1909 1910	<i>Gym. cornutum</i> (Pers.) Arth.	<i>Juniperus sibirica</i> 131, 165, 194	<i>Sorbus americana</i> 131, 165, 194 <i>S. aucuparia</i> 165
1908 1909	<i>Gym. exterum</i> Arth. & Kern	<i>Juniperus virginiana</i> 144, 166	<i>Porteranthus stipulatus</i> 144, 166
1911	<i>Gym. juniperinum</i> (L.) Mart. (<i>G. tremel-</i> <i>loides</i> Hartig)	<i>Juniperus sibirica</i> 211	<i>Sorbus americana</i> 211
1911 1912	<i>Gym. gracilens</i> (Peck) Kern & Bethel	<i>Juniperus monosperma</i> 217 <i>J. utahensis</i> 237	<i>Philadelphus coronarius</i> 217, 237 <i>P. Keteleerii</i> 237
1911	<i>Gym. effusum</i> Kern	<i>Juniperus virginiana</i> 217	<i>Aronia arbutifolia</i> 217
1907 1908 1910 1911 1913	<i>Gym. clavariaeforme</i> (Jacq.) DC.	<i>Juniperus sibirica</i> 108, 130, 194, 210, 238	<i>Amelanchier erecta</i> 130, 194, 210 <i>A. intermedia</i> 108 <i>Crataegus cerronis</i> 238 <i>C. punctata</i> 194
1914	<i>Gym. Ellisii</i> (Berk.) Farl.	<i>Chamaecyparis thyoides</i> 246	<i>Myrica cerifera</i> 246
1907 1908 1909 1910 1912	<i>Gym. Betheli</i> Kern	<i>Juniperus scopulorum</i> 112, 113, 131, 165, 195, 237	<i>Crataegus cerronis</i> 165, 195 <i>C. coccinea</i> 112 <i>C. cordata</i> 113 <i>C. Pringlei</i> 237 <i>C. punctata</i> 112 <i>C. sp.</i> 131 <i>Sorbus americana</i> 112, 113, 131
1906 1907 1908 1909	<i>Gym. globosum</i> Farl.	<i>Juniperus virginiana</i> 90, 107, 130, 164	<i>Crataegus coccinea</i> 164 <i>C. Pringlei</i> 90, 130 <i>Malus coronaria</i> 90 <i>M. Malus</i> (<i>Pyrus</i> <i>Malus</i>) 107 <i>Sorbus americana</i> 90
1911 1912	<i>Gym. Nelsoni</i> Arth.	<i>Juniperus scopulorum</i> 237 <i>J. utahensis</i> 215	<i>Amelanchier canadensis</i> 237 <i>A. vulgaris</i> 215

Year	Rust	Telial host	Aecial host
1909	<i>Gym. corniculans</i> Kern	<i>Juniperus horizontalis</i> 170	<i>Amelanchier canadensis</i> 170 <i>A. erecta</i> 170
1908 1909	<i>Gym. floriforme</i> Thax.	<i>Juniperus virginiana</i> 129, 166	<i>Crataegus coccinea</i> 166 <i>C. punctata</i> 129
1905 1906 1907 1908 1910	<i>Gym. Juniperi-virginianae</i> Schw.	<i>Juniperus virginiana</i> 64, 90, 106, 129, 193	<i>Malus coronaria</i> 90, 129 <i>M. Malus (Pyrus Malus)</i> 64, 106, 129, 193
1905 1906	<i>Tranz. punctata</i> (Pers.) Arth. (<i>Puc. Prunispinosae</i> Pers.)	<i>Prunus pumila</i> 89 <i>P. serotina</i> 71, 89	<i>Hepatica acutiloba</i> 71, 89
1903 1904 1905 1908	<i>Mel. Medusae</i> Thüm.	<i>Populus deltoides</i> 35, 46, 64 <i>P. tremuloides</i> 47, 133	<i>Larix decidua</i> 35, 46, 47, 64 <i>L. laricina</i> 46, 64, 133
1910 1911	<i>Mel. albertensis</i> Arth.	<i>Populus tremuloides</i> 198, 212	<i>Pseudotsuga mucronata</i> 198, 212
1904 1906	<i>Mel. Bigelowii</i> Thüm.	<i>Salix amygdaloides</i> 54 <i>Salix</i> sp. 84	<i>Larix decidua</i> 54, 84
1910	<i>Mel'sis abietina</i> (A. & S.) Arth.	<i>Ledum groenlandicum</i> 195	<i>Picea mariana</i> 195
1910	<i>Mel'ella elatina</i> (A. & S.) Arth.	<i>Cerastium oreophilum</i> 212	<i>Abies lasiocarpa</i> 212
1909	<i>Calyp. columnaris</i> (A. & S.) Körn.	<i>Vaccinium pennsylvanicum</i> 166	<i>Abies Fraseri</i> 166
1906 1910 1913	<i>Cron. Quercus</i> (Brond.) Schroet.	<i>Quercus Phellos</i> 238 <i>Q. rubra</i> 195, 238 <i>Q. velutina</i> 84	<i>Pinus virginiana</i> 84, 195 <i>P. taeda</i> 238
1910 1911 1913 1914	<i>Coleos. Vernoniae</i> B. & C.	<i>Vernonia crinita</i> 198 <i>V. fasciculata</i> 239, 243 <i>V. gigantea</i> 211	<i>Pinus palustris</i> 239 <i>P. taeda</i> 198, 211, 239, 243

INDEX

A consecutive paging of the reports has been adopted in order to simplify the index. It corresponds to the original paging as follows:

Pages	1-9 (Botanical Gazette 29: 268-276).
"	10-15 (Journal of Mycology 8: 51-56).
"	16-29 (Botanical Gazette 35: 10-23).
"	30-43 (Journal of Mycology 10: 8-21).
"	44-61 (Journal of Mycology 11: 50-67).
"	62-78 (Journal of Mycology 12: 11-27).
"	79-95 (Journal of Mycology 13: 189-205).
"	96-115 (Journal of Mycology 14: 7-26).
"	116-147 (Mycologia 1: 225-256).
"	148-175 (Mycologia 2: 213-240).
"	176-202 (Mycologia 4: 7-33).
"	203-219 (Mycologia 4: 49-65).
"	220-248 (Mycologia 7: 61-89).
"	249-265 (Mycologia 8: 125-141).
"	266-284 (Mycologia 9: 294-312).
"	285-296 (Mycologia 13: 12-23).
"	279-329 (Mycologia 13: 230-262).

Names in *italics* are synonyms.

Numbers in broad-faced type indicate successful cultures.

Numbers in square brackets refer to pages (1) where the common name is used for the species instead of the Latin name, or (2) where the name occurs but is not the species intended and not a synonym (*e.g.*, *Anchusa officinalis* for *Lycopsis arvensis*), or (3) where the name does not occur but some other name not a synonym (the error being due to wrong identification, *e.g.*, *Gymnosporangium Nelsoni* used for *G. juvenescens*, or to common but erroneous usage, *e.g.*, *Spartina cynosuroides* for *S. Michauxiana*).

FUNGUS INDEX

- Aecidium abundans* (Puc. Crandal-
 lii) 197
albiperidium (Puc. Grossulariae)
 12, 15
alliicolum (Urom. Sporoboli) 273,
 275
Asterum (Puc. extensicola) 13, 15
Berberidis (Puc. poculiformis) 15
Blasdaleanum (Gym. Libocedri)
 143
Calystegiae (Puc. Convolvuli) 9
Ceanothi (Puc. Ceanothi) 168
Cephalanthi (Puc. Seymouriana)
 75
Clematidis or *Clematidis* (Puc.
 Agropyri) 57
compositarum Silphii (Urom. Sil-
 phii) 92
cornutum (Gym. cornutum) 132
Dracunculi (Puc. universalis) 110
elatinum (Melampsorella elatina)
 212
erigeronatum (Puc. extensicola)
 13, 15
Euphorbiae (Urom. Euphorbiae) 9,
 15
Fraxini (Puc. fraxinata) 8, 9
funariaceum (Puc. subnitens) 278
hepaticatum (Puc. Pruni-spinosae)
 71
houstoniatum (Urom. houstoniat-
 us) 128
Hydrophylli (Puc. apocrypta) 262,
 265
hynoideum 41
Impatientis (Puc. Impatientis) 24
Iridis (Puc. Majanthae) 253
Jamesianum (Puc. Jamesiana) 24
leucospermum (Urom. Lespedezae-
 procumbentis) 36
Liatriidis (Puc. Liatriidis) 273
Lycopi (Puc. angustata) 6, 9, 15
macrosporum (Puc. macrospora)
 135
magnatum (Urom. magnatus) 282
malvicola (Puc. Muhlenbergiae)
 272
monoicum (Puc. monoica) 213
Napaeae (Puc. Muhlenbergiae)
 142
Nesaeae (Puc. minutissima) 245
obesum (Puc. Seymouriana) 258,
 265
occidentale (Puc. Agropyri) 57
Oxalidis (Puc. Sorghi) 59
Pammelii (Puc. Pammelii) 50
Peckii (Puc. Peckii) 19
Pentstemonis (Puc. Andropogonis)
 5, 9
Phrymae (Puc. Phrymae) 111
Polemonii (Urom. acuminatus)
 198
Pteleae (Puc. Windsoriae) 6, 9, 22
punctatum (Puc. Pruni-spinosae)
 70
pustulatum (Puc. pustulata) 39
Ranunculi (Puc. Eatoniae) 40
rubellum (Puc. Phragmitis) 3, 9
Sambuci (Puc. Sambuci) 14, 15,
 20
sanguinolentum (Puc. Polygoni-
 amphibii) 32, 53, 69
sclerothecioides (Puc. Stipae) 189
Silphii (Urom. Silphii) 92
Solidaginis (Puc. extensicola) 27
Urticae (Puc. Caricis) 3, 9, 15
verbenicola (Puc. verbenicola) 7,
 9, 22
Bullaria tumidipes 260
Vernoniae 274
Caeoma erigeronatum (Puc. exten-
 sicola) 13
miniata (Phrag. speciosum) 4, 9
occidentale (Melampsora alberten-
 sis) 199
Ulmariae (Triphragmium Ulmari-
 ae) 9
Calyptospora columnaris 166, 175
Coleosporium Campanulae 46
Vernoniae 198, 202, 211, 219, 239,
 243, 248
Cronartium Quercus 84, 94, 195, 202,
 239, 248
Gymnoconia interstitialis 207

- Gymnosporangium Betheli 112, 115,
 131, 147, 165, 174, 194, 201, 237,
 247
biseptatum (G. Botryapites) 131
 Botryapites 131, 147, 242, 248
 clavariaeforme 108, 115, 130, 146,
 193, 201, 210, 218, 238, 247
 clavipes 107, 115, 130, 146, 164,
 174, 193, 201
 corniculans 170, 171, 175
 cornutum 131, 147, 165, 174, 194,
 201
 Davisii 132, 147, 151, 194, 201
durum (G. Nelsoni) 215, 219, 237,
 247
 effusum 216, 219
 Ellisii 245, 248
 exiguum 169, 175
 exterum 144, 147, 166, 175
 floriforme [129], [146], 166, 174
 globosum 90, 95, 107, 114, 130, 146,
 164, 174
 gracilens 217, 219, 237, 247
 inconspicuum 113, 115, 211, 218
 juniperinum 211, 219
 Juniperi-virginianae 64, 77, 90, 95,
 106, 114, 129, 146, 193, 201
 juvenescens [93], [95], [107],
 [114], [130], [146], [195],
 [201], 216
 Kernianum 216, 219
 Libocedri 143, 147, 211, 219
macrospus (G. Juniperi-virginianae)
 65
 Nelsoni [93], [95], [107], [114],
 [130], [146], [195], [201],
 215, 219, 237, 247
 Nidus-avis 108, 115, 165, 174, 194,
 201, 210, 218, 242, 248
speciosum (G. gracilens) 217
 trachysorum 172, 175
tremelloides (G. juniperinum)
 132, 211, 219
 Lecythea macrosora (Mel. Bigelowii)
 55
 Melampora albertensis 198, 202,
 212, 219
 Bigelowii 54, 61, 84, 94
 Lini 91, 95
 Medusae 35, 42, 46, 60, 64, 77,
 133, 147
paradoxa (M. Bigelowii) 55
 Melampsorella elatina 212, 219
 Melampsoropsis abietina 195, 202
 Nigredo Polemonii 282
 Peridermium carneum (Coleos. Ver-
 noniae) 198, 211, 239, 243
Cerebrum (Cronart. Quercus) 84,
 195
fusiforme (Cronart. Quercus) 238,
 248
 Phragmidium speciosum 4, 9, 23, 28,
 47, 60, 106, 114
 Puccinia Absinthii 134, 147, 190, 201
 Agropyri [100], 104, 114, 232,
 241, 247, 252, [256], [265], 276,
 292, 293
albiperidia (P. Grossulariae) 12,
 15, 33, 42, 52, 61, 65, 77, 86, 94,
 102, 113, 184, 226, 227, 237, 246,
 290
alternans (P. Agropyri) 139, 147,
 [256], [265], 293
 americana (error for P. Andro-
 pogonis) [5], [9]
 amphigena 26, 29, 33, 42, 67, 77,
 104, 114, 160, 173, 187, 200, 250
 Andropogonis [5], [9], 33, 42, 87,
 94, 186, 200
 angustata 6, 9, 12, 15, 52, 61, 86,
 94, 103, 114, 125, 146, 186, 200,
 208, 218, 229, 247
 Anthoxanthi 180
 apocrypta (partly error for P. mon-
 tanensis) [261], 262, [263],
 [265]
 argentata 189, 201
 Arundinariae 100
 Asperifolii 127, 146, 257, 265
 Asteris 123
 Asterum 288
Atkinsoniana (P. Sambuci) 11, 20,
 21
Bartholomaei (P. Jamesiana) 24
 Blasdalei [112], [115]
Bolleyana (P. Sambuci) 14, 15,
 20, 21, 52
 canaliculata 74, 78

- caricina 11, 293
 Caricis 3, 9, 11, 15, 22, 28, 66, 77,
 103, 113, 158, 173, 186, 200, 293
Caricis-Asteris (P. extensicola)
 13, 15, 21, 28, 102, 113, 159,
 173, 185, 197, 199, 228, 246, 287
Caricis-Erigerontis (P. extensi-
 cola) 12, 15, 21, 28, 52, 61, 287
Caricis-Solidaginis (P. extensi-
 cola) 27, 29, 66, 77, 124, 146,
 184, 199, 228, 246, 287
 Caricis-strictae 66
 caulicola 36, 42
 Ceanothi 168, 175
 Chloridis 18
cinerea (P. Agropyri) 137, 147,
 208, 218, 292, 293
 Clematidis 293
 Cockerelliana [256], [265]
 Convolvuli 3, 9
 Crandallii 64, 100, 196, 202
 Cryptandri [109], [115], 223, 280
 Distichlidis 154, 180, 260, 265, 271,
 275, 291
Dulichii (P. extensicola) 121, 240,
 246, 254, 264
 Eatoniae 40, 42, 295
 Eleocharidis 17, 74, 78, 87, 94, 124,
 146
 Ellisiana 99, 122, 155, 178, 230,
 247
 emaculata 11, 18, 32, 63, 82, 100,
 121, 224, 251, 276
 Eriophori 255, 265
exitiosa (P. transformans) 73
 extensicola 229, 238, 239, 246, 254,
 264, 288, 289
 fraxinata 51, 60, 67, 77, 103, 114,
 127, 146, 160, 174
graminis (P. poculiformis) 295, 296
 Grindelae 72, 78
 Grossulariae 182, 199, 225, 246,
 254, 265, 290
 Helianthi 23, 28, 34, 42, 47, 60,
 69, 78, 287
 hydroidea (error) 41, 42, 57
 Impatientis 25, 29, 33, 42, 51, 60,
 161, 174, 292
 Isiacae 294
 Jamesiana 24, 28, 138, 200
 Koeleriae 138, 147
 Kuhniae 74, 78, 124, 145
 lateripes 69, 78, 294
 Liatridis 273, 275, 292
 Lithospermi 197, 202
 ludibunda 46
 Lygodesmiae 212, 219
 macrospora 135, 147
 Majanthae 277, 284
 McClatchieana 223
 minutissima 245, 248
 monoica 215, 219, 234, 247
 montanensis (partly error for P.
 apocrypta) [106], [180], [261],
 262, [263], [265]
 Muhlenbergiae 17, 142, 147, 161,
 174, 187, 200, 241, 247, 271, 275
 mutabilis [112], [115]
nigrescens (P. caulicola) 37
 nodosa 244, 248
obliterata (P. Agropyri) 141, 147,
 160, 174, 293
 obtecta 109, 115
Opizii (P. patruelis) 84, 94, 185,
 200
 Pammelii 50, 60, 67, 77, 105, 114
Panici (P. Pammelii) 50
Paniculariae (P. Agropyri) 18
 patruelis 136, 147
 Peckii 11, 19, 28, 52, 61, 66, 77,
 85, 94, 124, 145, 157, 173, 184,
 199, 208, 218
peridermiospora (P. fraxinata) 8,
 9
perminuta (P. Impatientis) 178
 Phragmitis 2, 9, 104, 114, 160, 174,
 208, 218
 Phrymae 111, 115
 poculiformis 12, 15, 51, 61, 68, 77,
 88, 94, 105, 114, 122, 162, 174,
 187, 200, 270, 275
 Podophylli 59, 61
 Polygoni-amphibii 18, 31, 53, 61,
 69, 78, 82
Pruni-spinosae (Tranzschelia punc-
 tata) 70, 78, 89, 94
 purpurea 18
 pustulata 40, 42, 67, 77, 186, 200

- quadriporula* (P. Grossulariae) 197, 202, 235, 246
quadriporula (error for Urom. perigynius) [197], [202], 235
 Rhamni 52, 61, 187, 200, 252, 271, 275
Ribesii-Caricis (P. Grossulariae) 228
rubigo-vera 11, 128, 154, 291, 293
Ruelliae 294
Salviae-lanceolatae (P. caulicola) 37
Sambuci 21, 28, 52, 65, 77, 85, 94, 124, 146
Schedonnardi (P. Muhlenbergiae) 17, 82, 100, 122, 179, 207, 271, 275
Seymouriana 75, 78, 127, 146, 188, 200, 249, 258, 265
Silphii 72, 78, 88, 94
simillima 26, 29, 104, 114, 251
Solidaginis 73, 78
Sorghii 59, 61, 68, 78
Sporoboli 18, 279, 284
splendens 244, 248
Stipae 18, 57, 59, 61, 188, 200, 231, 247
striatula (P. Majanthae) 154
subnitens 25, 29, 48, 60, 67, 77, 87, 94, 104, 114, 125, 146, 160, 173, 187, 200, 208, 209, 218, 259, 265, 272, 275, 278, 284, 289, 293, 294
substerilis 75, 78, [109], [115], 154, 163, 174
Sydowiana (P. verbenicola) 7
tenuistipes 102
tomipara (P. Agropyri) [411, 56, 61, 87, 94, 127, 146, 233, 293
tosta (P. Muhlenbergiae) 32, 63, 179, 206, 240, 247
transformans 73, 78, 88, 94
trititina (P. Agropyri) 276, 292, 293
tumidipes 260, 265
uniporula (P. Grossulariae) 226, 227, 254, 265
universalis 110, 115, 159, 173, 185, 200, 270, 275
verbenicola [7], [9], 22, 28, 50, 60, 67, 77
Vernoniae 274, 275
vexans 32, 109, 115, 122
Vilfae (P. verbenicola) 7, 9, 22
virgata 99, 154, 179
vulpinoidis (P. extensicola) 120, 238, 246, 288
Windsoriae 6, 9, 22, 28, 50, 60, 259, 265
Xanthii 71, 78, 88, 94
Pucciniastrum Hydrangeae 277
Roestelia Betheli (Gym. Betheli) 113
cornuta (Gym. cornutum) 118, 150
Harknessianoides (Gym. inconspicuum) 113
hyalina (Gym. hyalinum) 150
penicillata (Gym. juniperinum) 118, 132
Tranzschelia punctata (Puc. Prunispinosae) 139
Tremella juniperina (Gym. juniperinum) 132
Triphragmium Ulmariae 4, 9
Uredo Oxytropi (Urom. Astragali) 192
rubigo-vera (Puc. Agropyri) 19, 28
Uromyces acuminatus 31, 75, 78, 83, 106, 114, 156, 198, 202, 236, 247, 283
Andropogonis 123, 163, 174
Archerianus 253
Aristidae (U. seditiosus) 23, 28
Astragali 192, 201
Caricis (Puc. Caricis-strictae) 66
effusus 83, 93
elegans 244, 248
Eleocharidis 83, 181
Euphorbiae 3, 9, 10, 15, 18, 28, 287
graminicola 64, 123, 155, 181, 269
Halstedii 17
Hordei 263, 265
houstoniatus 128, 146
Junci 17, 64, 93, 101, 155, 191, 201, 235, 247
Lespedezae-procumbentis 36, 42
magnatus 283, 284

- Medicaginis* 193, 201, 210, 218
Murrilli (*U. houstoniatus*) 128
Orobi 101
Peckianus 181, 209, 218, 289
perigynius 38, 190, [197], 201,
 234, 242, 247, 279, 284, 288, 293
Phaseoli 36, 42
Polemonii 282, 291
Rhynchosporae 101, 224
Scirpi 89, 94, 106, 114, 128, 146,
 242, 247, 253
sediciosus 278, 284
Silphii 92, 93, 95, 106, 114
Solidagini-Caricis (*U. perigynius*)
 38, 42
Spartinae 164, 174, 181, 283
Sporoboli 17, 182, 225, 273, 275,
 280
Steironematis 283
uniporus 183, 291

HOST INDEX

- Abies alba* 167
balsamea 17, 167, 277
concolor 167, 277
Fraseri 166, 167, 175
lasiocarpa 212, 219
magnifica 167
nobilis 167
Abronia fragrans 155, 273, 275, 278
umbellata 121, 223
Actaea alba 46, 51, 81, 82, 99, 122,
 154, 162, 178, 223
rubra 81
Adelia acuminata 51, 67
ligustrina 51, 127
segregata 51, 127
Adoxa moschatellina 189, 201
Aesculus glabra 18, 63, 81, 98, 99,
 100, 101, 155, 180, 181, 206, 207,
 224
Agoseris glauca 136, 147, 159
Agropyron biflorum 140, 142, 147
caninum 142
glaucum 276
pseudorepens 105, 114, 162, 174
repens 51, 61, 101, 163
Smithii 232, 247, 270, 275, 276
sp. 105, 160, 174
tenerum 51, 61, 105, 114, 163, 187,
 200, 262, 265
Agrostis alba 68, 77, 88, 94, 163, 187,
 200
hyemalis 178
perennans 178
sp. 271, 275
Allium Brandegei [112], [115]
canadense 274, 280
cernuum [112], [115], 280, 284
Nuttallii 280, 284
recurvatum [112], [115]
reticulatum [112], [115] 225, 274
stellatum 273, 275, 278, 280
Althaea rosea 81, 82, 123, 155, 161,
 187
Ambrosia artemisiaefolia 63, 76, 92,
 236
psilostachya 192, 235, 236, 247
trifida 6, 11, 25, 32, 45, 65, 71, 81,
 82, 92, 101, 120, 121, 122, 134,
 153, 154, 168, 180, 191, 236, 247
Amelanchier Botryapium 65, 107, 133
canadensis 93, 95, 101, 107, 108,
 109, 113, 114, 143, 165, 169, 170,
 171, 175, 217, 237, 242, 243, 247,
 248
erecta 107, 113, 114, 115, 130, 132,
 146, 157, 164, 165, 170, 171, 174,
 175, 194, 195, 201, 207, 210, 211,
 216, 217, 218
intermedia 107, 108, 114, 115, 131,
 147, 171
sp. 90
vulgaris 133, 194, 201, 211, 215,
 216, 217, 218, 219, 242, 248
Amorpha fruticosa 121, 179, 181
nana 168, 179, 180, 182
Amsonia salicifolia 243, 258
Amygdalis communis 70
persica 71, 89
Anchusa officinalis [257], [265]
Andropogon furcatus 6, 39, 42, 67,
 77, 186, 200
glomeratus 123, 155

- Hallii 168, 169, 175
 scoparius 5, 6, 33, 39, 42, 87, 94,
 99, 122, 155, 178, 186, 200
 sp. 186, 230, 247
 virginicus 163, 174, 186, 200
Anemone canadensis 17, 19, 26, 29,
 64, 104, 114, 252
 coronaria 70
 cylindrica 26, 232, 247, 251, 252,
 256, 276
 pennsylvanica 32
 ranunculoides 71
 virginiana 17, 26, 81, 104, 122
Anemone thalictroides 81, 82, 98,
 178
Anthoxanthum odoratum 180
Apios Apios (A. tuberosa) 46, 81, 82,
 123, 179, 181, 225
Apocynum cannabinum 17, 24, 32,
 101, 122, 153, 178, 179, 180, 181,
 182, 197, 224, 258, 265
 hypericifolium 258
Aquilegia caerulea 101, 141, 232
 canadensis 64, 140, 147, 178, 242,
 256
 elegantula 141
 flavescens 141, 232, 242
 formosa 141
 sp. 252
 truncata 141
Arabis Drummondii 214
 Holboellii 120, 154, 159, 179, 180,
 189
 retrofracta 215
 sp. 99, 101, 213, 214, 219, 234, 247
Aragallus Lamberti 192, 201
Arisaema triphyllum 91
Aristida basiramea 279, 284
 oligantha 23, 28
 ramosissima 279
Arnica sp. 155, 179, 180, 182, 189,
 191, 196
Aronia arbutifolia 108, 157, 194, 201,
 217, 219, 242
 nigra 93, 130, 132, 147, 165, 194,
 201
 rotundifolia 133
Artemisia canadensis 111
 dracunculoides 99, 110, 111, 115,
 121, 134, 147, 154, 159, 173, 185,
 190, 200, 201, 269
 dracunculus 110, 111
 frigida 111
 gnaphalodes 270, 275
 kansana 111
 longifolia 159
 ludoviciana 190
 serrata 99
 sp. 190, 201
Arundinaria macrosperma 100
Asclepias incarnata 24, 28, 45
 pulchra 258
 syriaca 24, 28, 188, 200, 258, 259,
 265
 verticillata 225
Asclepiodora decumbens 24
Asprella Hystrix 262
Aster adscendens 159, 173, 185, 199
 arenarioides [123]
 cordifolius 11, 13, 14, 58, 102, 113
 Drummondii 32, 58, 66, 121, 123,
 124, 153, 178, 190, 238, 240, 242
 ericoides 32, 58, 59, 61, 75, 154,
 188, 190, 200, 201, 231
 lateriflorus 279
 multiflorus 57, 58, 59, 61, 75, 123,
 153, 154, 188, 200, 231
 Novae-Angliae 58, 59, 61, 75, 188,
 200, 231
 paniculatus 11, 12, 13, 14, 19, 20,
 21, 28, 32, 58, 66, 100, 102, 111,
 113, 120, 121, 123, 124, 153, 179,
 182, 184, 190, 197, 201, 202, 224,
 228, 229, 234, 235, 238, 240, 242,
 243, 246, 247, 254
 prenanthoides 20, 32
 sericeus 58
 Shortii 19
 Tripoli 229
 Tweedyi 153, 159, 185, 240, 242,
 247
Astragalus canadensis 182
 carolinianus 192, 201
 sulphureus 192, 201
Atheropogon curtispendus 24, 28,
 109, 115, 122, 188, 200

- Atriplex confertifolia* 206
hastata 126, 146, 160, 173, 208, 209, 218, 289
Avena sativa 52, 61, 88, 105, 114, 163
Baptisia bracteata 225
leucantha 110
tinctoria 45, 142, 155, 168
Berberis Aquifolium 138
repens 138
vulgaris 12, 51, 61, 68, 77, 88, 94, 105, 114, 122, 138, 162, 174, 180, 187, 200, 270, 271, 275
Berula angustifolia 89
Bidens connata 109, 115
frondosa 17, 101, 109, 110, 115
Boehmeria cylindrica 153, 158, 162, 168, 179, 186, 197
Boltonia asteroides 18, 32, 81, 99, 121, 179, 181, 189, 269, 270
Bouteloua curtipendula (see *Atheropogon*) 24, 32
racemosa 109, 122
Brauneria purpurea 18
Brodiaea pauciflora 244, 248
Bromus ciliatus 11, 19, 41, 42, 56, 57, 61, 276
Porteri 139, 140, 147
Pumpellianus 139, 140
purgans 57, 87, 94, 127, 146
Richardsoni 140
Bursa bursa-pastoris 68, 77, 87, 100, 104, 114, 209
Cacalia reniformis 81, 120, 121, 123
Calamagrostis canadensis 154, 187, 200
Calamovilfa longifolia 26, 29, 33, 42, 67, 77, 104, 114, 160, 173, 187, 200, 250
Callirhoe digitata 223, 224, 240, 241
involutrata 32, 81, 82, 83, 120, 123, 142, 147, 154, 155, 161, 174, 187, 200, 207, 224, 240, 241
Callistephus hortensis 123
Campanula americana 46
Campsis radicans 73
Capnoides montanum 277, 278
Cardamine bulbosa 100, 126
Carduus Flodmanii 180, 191, 192, 201, 236, 247
undulatus 154, 158, 168
Carex aquatilis (error for *C. nebrascensis*) [66], [77]
arctata 178, 226, 246, 254, 265
aristata 158, 173, 186, 200
Backii 153, 269
blanda (see *tetanica*)
Bonplandii minor 153
brunescens 197
cephalophora 3
comosa 119, 134, 136, 147
crinta 53, 61, 86, 94, 102, 113, 226, 246
deflexa 190, 191, 201
Douglasii 99
durifolia 255, 269
extensa 229
festiva 159, 173, 185, 199
festucacea 13, 21, 28, 52, 61
filifolia 270, 275
filiformis 245, 248
foeneia 13, 14, 21, 28
Frankii 85, 94
Goodenovii 197, 202, 235
gracillima 33, 38, 39, 42, 53, 61, 183
gravida 32, 46, 81, 99, 121
intumescens 190, 191, 201, 234, 247
Jamesii 27, 29, 66, 255
lanuginosa 37, 38, 39, 52, 61, 66, 77, 85, 94, 157, 173, 184, 199, 208, 218
longirostris 111, 112, 115
lupulina 65, 77, 85
lurida 11, 21, 28, 85, 124, 146
maritima 221
nebrascensis (under *C. aquatilis*) [66], [77]
pallescens 182, 183, 199
pennsylvanica 32, 45, 63, 81, 98, 120, 176, 178
praecox 158
pratensis 136, 137, 147
pubescens 12, 38, 39, 183, 225, 226, 246, 254
retrorsa 228, 246
riparia 22, 28, 103, 113
rosea 102, 113

- scoparia* 184, 191, 199, 228, 229, 246
siccata 154, 185, 200
sparganioides 66, 77, 124, 146, 279, 284
sp. 85, 94, 102, 121, 208, 237
squarrosa 86, 94
stellulata 178
stenophylla 110, 111, 115, 134, 159, 173, 185, 200, 270
stipata 20, 27, 28, 29, 66, 77, 103, 113, 124, 145
stricta 3, 11, 22, 28, 66, 186, 200
tenella 153, 178
tenuis 153, 182, 183, 199, 226, 246, 254, 265
tetanic (error for *blanda*) 11, 65, 77, 86, 94
tribuloides 242, 247
trichocarpa 11, 14, 19, 20, 21, 28, 52, 61, 85, 94, 158, 173, 184, 199
trisperma 178
varia 37, 38, 39, 42, [102], [191]
virescens 38, 39
vulpinoidea 120, 238, 240, 246
Cassia chamaecrista 17, 18, 32, 64, 76, 81, 83, 99, 100, 101, 155, 168, 180, 181, 225
Caulophyllum thalictroides 82, 99, 122, 162, 178
Ceanothus americanus 17, 32, 81, 82, 99, 142, 154, 155, 168, 175
ovatus 168
Cephalanthus occidentalis 75, 78, 127, 146, 188, 200, 258
Cerastium oreophilum 212, 219
Chamaecyparis thyoides 131, 147, 242, 245, 248
Cheiranthus Menziesii 213
Chelone glabra 120, 154, 155, 178, 223, 224
Chenopodium album 25, 29, 49, 50, 60, 87, 94, 104, 114, 126, 146, 160, 173, 187, 188, 200, 208, 209, 218, 253, 259, 265, 278, 284, 293
glaucum 50
hybridum 126
leptophyllum 25, 50
Chionanthus virginica 51
Chrysopsis villosus 231
Chloris elegans 253
verticillata 18
Chrysopogon avenaceus 99, 154, 179
Chrysothamnus nauseolus 73
Cicuta maculata 32, 53, 89, 90, 94, 106, 114, 128, 146, 242
Cimicifuga americana 51
racemosa 51
Cineraria palustris 255
Cinna arundinacea 12, 163
Clematis Douglasii 57, 232, 242
Drummondii 57, 241, 242, 247, 276
Flammula 276, 292
Fremontii 56, 57
lasiantha 57
ligusticifolia 57, 105, 232, 233, 247, 252, 256, 276, 292
Scottii 51, 56, 57
viorna 56, 57
virginiana 51, 56, 57, 61, 87, 94, 105, 114, 127, 146, 180, 232, 233, 242, 276, 292
vitalba 104, 276
Cleome serrulata 49, 50
spinosa 32, 49, 60, 208, 209, 218
Cleomella parviflora 50
Collomia linearis 236, 247
Comandra pallida 39
umbellata 39, 42, 67, 77, 123, 186, 200
Convallaria majalis 180, 278
Convolvulus sepium 3, 5
Corydalis aurea 160, 187, 225
glauca 160
montana 209
sempervirens 160, 188
Crataegus apiifolia 172
cerronis 157, 165, 172, 174, 175, 195, 201, 211, 216, 219, 238, 248
coccinea 65, 112, 115, 157, 164, 166, 172, 174, 175
cordata 113, 115, 173
flavo-carius 173
Marshallii 172
Phaenopyrum 173
Pringlei 90, 93, 95, 130, 143, 146,

- 147, 165, 169, 174, 175, 237, 247
punctata 106, 112, 115, 129, 130,
 144, 146, 157, 164, 172, 174, 175,
 194, 201, 237
 sp. 107, 113, 130, 131, 146, 147, 157,
 170
tomentosa 108, 193, 194, 201, 211,
 217, 219
Cydonia vulgaris 157, 194, 195, 201,
 210
Cyperus esculentus 74, 78
Dactylis glomerata 19
Dalea laxiflora 122, 142
Dasystema flava 123
Decodon verticillatus 101, 121, 123,
 126, 245, 248
Delphinium formosum 179
 Geyeri 232
 scaposum 168, 180
 tricorne 100, 122, 180
Dirca palustris 41, 42, 56, 57, 81, 82,
 86, 101, 122, 154, 162, 178, 179,
 180, 181, 223, 224, 259
Distichlis spicata 25, 29, 48, 49, 60,
 67, 77, 87, 94, 104, 114, 125, 146,
 160, 173, 181, 187, 200, 206, 208,
 209, 218, 259, 265, 272, 275, 278,
 284, 289, 293
Dodecatheon Meadia 64
Doellingeria umbellata 184, 224
Dulichium arundinaceum 121, 240,
 246, 254, 264
Draba caroliniana 100
Eatonia pennsylvanica 40, 42
Eleagnus angustifolia 180, 182
 argentea 224, 232, 252, 269, 270
Eleocharis palustris 17, 74, 78, 83, 87,
 94, 124, 146, 181
Elephantopus carolinianus 198, 243
Elymus brachystachys 100
 canadensis 32, 45, 51, 61, 88, 94,
 162, 163, 174, 180, 232, 247, 270,
 275, 276
 condensatus 100, 262
 striatus 161, 162, 174
 virginicus 25, 29, 33, 42, 51, 60, 162,
 174, 241, 247, 262, 265, 276, 292
Erigeron annuus 11, 13, 14, 19, 21, 27,
 28, 45, 52, 61, 102, 111, 153, 182,
 225, 234
 arenarioides [123]
 philadelphicus 22, 28
Eriocoma cuspidata 101
Eriophorum angustifolium 255
 polystachyon 256
 tenellum 256
 virginicum 256
 viridicarinatum 255, 256, 265
Erysimum asperum 49, 60, 68, 77
Euonymus obovatus 17, 46, 54
Eupatorium perfoliatum 11, 18, 32,
 74, 78, 87, 94, 124, 146
 serotinum 154, 181
Euphorbia arkansana coloradensis 101
 commutata 36, 182, 276
 corollata 50, 60, 67, 77, 105, 224,
 251, 269, 276, 277
 cyparissias 192, 193, 224
 dentata 19, 28
 humistrata 18, 19, 28
 Ipecacuanhae 277
 maculata 4, 10, 11
 marginata 18, 19, 105, 114
 nutans 4, 10, 11, 18, 19, 28
 robusta 267
Euthamia graminifolia 184, 199, 229,
 234, 242, 243, 246
Evolvulus pilosus 197, 202
Falcata comosa 64, 81, 99, 100
Festuca confinis 64, 100, 196, 202
 Thurberi 256, 265
Forestiera porulosa 51
Fraxinus lanceolata (*F. viridis*) [8],
 51, 60, 67, 77, 103, 114, 127, 146,
 160, 174, 180
Gaura biennis 158, [173], 184
Geranium carolinianum 82
 maculatum 13, 19, 22, 32, 53, 61,
 69, 78, 81
 palustre 82
 pratense 82
 pusillum 69, 81, 82
 Robertianum 69, 81
Gillenia stipulacea 117, 144, 145, 166
Glaux maritima 89, 90

- Grindelia squarrosa* 122, 154, 155, 179, 188, 189, 191, 196, 200, 231
Gutierrezia Sarothrae 64, 72, 73, 78, 231, 247
Helianthus angustifolius 224
 annuus 34, 42, 48, 60, 69, 78, 287
 decapetalus 48
 divaricatus 48, 60
 grosse-serratus 17, 23, 28, 34, 47, 48, 60, 69, 78
 hirsutus 48, 60
 Kellermani 48, 60
 laetiflorus 47, 48, 60
 Maximiliani 18, 23, 28, 34, 48
 mollis 34, 42, 47, 48, 60
 occidentalis 48, 60
 orygalis 48
 rigidus 34
 scaberrimus 48, 60
 strumosus 17, 23, 34, 48, 60
 tomentosus 34, 48, 60
 tuberosus 34, 48
Heliotropium curassavicum 154
Hepatica acuta 11
 acutiloba 71, 78, 89, 94
Hibiscus militaris 45, 123, 142, 155, 187, 223, 241
 Moscheutos 81, 82, 100, 142
Hippurus vulgaris 89
Holcus lanatus 252
Homalocenchrus virginicus 17
Hordeum jubatum 19, 154, 252
 nodosum [264]
 pusillum 263, 264, 265
 vulgare 88, 94, 163
Houstonia caerulea 92, 128, 129, 146, 277, 279
 purpurea 82, 83, 92, 99
Hydrangea arborescens 277
Hydrocotyle australis 253
Hydrophyllum appendiculatum 17, 18, 31, 64, 66
 capitatum 99, 179, 180, 196, 198, 207, 232, 262, 265
 Fendleri 223, 232
 virginicum 99, 100, 101, 121, 122, 154, 155, 162, 168, 179, 181, 189, 223
Hymenoclea monogyna 244, 248
Hypoxis erecta 99, 101
Ilex opaca 100
Impatiens aurea 11, 14, 17, 18, 19, 25, 29, 32, 33, 42, 51, 56, 60, 161, 162, 174, 180, 189, 201
Ipomoea pandurata 5, 122, 162, 239
Iris versicolor 17, 92, 99, 102, 121, 197, 223, 253, 277, 278, 282, 284
Isopyrum biternatum 18, 37, 81, 82, 122, 178, 180
Iva frutescens 122, 126, 134, 153
Juncus balticus 101, 155, 191, 192, 201, 235, 247
 dichotomus 93
 effusus 64, 82, 83
 tenuis 17, 92, 93, 95, 106, 114
Juniperus communis 133
 horizontalis 151, 170, 171, 175
 monosperma 217, 219
 scopulorum 93, 95, 107, 112, 114, 115, 130, 131, 146, 147, 165, 174, 194, 201, 237, 247
 sibirica 107, 108, 115, 130, 131, 132, 146, 147, 150, 151, 164, 165, 174, 193, 194, 201, 210, 211, 218, 219, 238, 248
 utahensis 113, 115, 211, 215, 216, 218, 219, 237, 247
 virginiana 64, 77, 90, 95, 106, 107, 108, 114, 115, 129, 130, 144, 145, 146, 147, 157, 164, 165, 166, 169, 171, 173, 174, 175, 193, 194, 195, 201, 210, 216, 218, 219, 242, 247
Koeleria cristata 137, 139, 147, 189, 200, 213, 234, 247, 273, 275, 292
Kuhnia eupatorioides 74, 78, 124, 145
 Hitchcockii 124, 145
Kuhnistera purpurea 17
Laciniaria Langloisii 243
 punctata 120, 154, 155, 178, 179, 211, 230, 243, 273, 275
 pyncnostachya 81
 scariosa 17, 18, 155, 181, 189, 198, 211, 236
 spicata 99, 100, 101, 121, 154, 155, 178, 179, 181
Lactuca canadensis 18, 32, 81, 82, 85, 92, 94, 99, 185, 200
 sativa 84, 85, 94, 154, 185, 200

- scariola (partly under *L. virosa*)
[85], [92], [94], 182
- Larix decidua* (*L. europaea*) 17, 35,
42, 46, 47, 54, 55, 60, 61, 64, 84,
94
- laricina* (*L. americana*) 46, 55, 60,
64, 77, 91, 133, 147, 198, 212
- Lyallii* 54, 55
- Lathyrus decapetalus* 101
- palustris* 101, 182
- Ledum groenlandicum* 195, 202
- Lepachys pinnata* 99, 100
- Lepargyrea canadensis* 153, 154, 155,
168, 179, 180, 181, 182, 224, 252
- Lepidium apetalum* [17], [45], [49],
[50], [60]
- densiflorum* [17], [45], [49], [50],
[60]
- virginicum* 49, 60, 68, 77, 209
- Leptilon canadense* 19, 22, 28
- Lespedeza capitata* 36, 42
- Leucocrocinum* sp. 251
- Liatris punctata* 273
- Libocedrus decurrens* 143, 147, 211,
219
- Ligularia sibirica* 255
- Ligustrum ovalifolium* 51
- vulgare* 51, 67, 127
- Lilium elegans* 279
- umbellatum* 279, 280, 284
- Linum Lewisii* 91, 95
- usitatissimum* 91, 95
- Lithospermum angustifolium* 154, 155,
230
- arvense* 154
- canescens* 154, 168, 179, 180
- officinale* 224
- Lobelia syphilitica* 46
- Lonicera japonica* 64
- Lycium pallidum* 260, 265
- vulgare* 260, 265
- Lycopsis arvensis* (partly under *An-
chusa officinalis*) 128, 146, 154,
[257], [265]
- Lycopus americanus* 6, 12, 52, 61, 87,
94, 103, 114, 125, 146, 186, 200,
208, 218, 230, 247
- communis* 125, 146
- Lygodesmia juncea* 212, 219
- Lysimachia quadrifolia* 76, 83, 100,
106, 121, 164, 178, 179
- terrestris* 76, 83, 178, 181, 182, 191,
197
- thyrsiflora* 76
- Macrocalyx Nyctelea* 46, 81, 82, 121,
180, 197
- Mahonia Aquifolium* 123, 138, 147,
180
- Maianthemum canadense* 278, 280, 282
- Malus coronaria* 90, 95, 107, 129, 146,
157, 195, 210, 217, 218
- ioensis* 164, 165, 174
- Malus* 64, 65, 77, 106, 107, 108, 114,
115, 129, 130, 131, 146, 157, 166,
193, 201, 217
- Malvastrum coccineum* 206, 225, 241,
271, 272, 275
- Medicago sativa* 182, 193, 201, 210,
218
- Menyanthes trifoliata* 101
- Merioliix serrulata* 178, 184, 199, 208
- Mertensia virginica* 100, 155
- sp. 101
- Mimulus ringens* 45, 154, 155, 162,
179, 181
- Monolepis Nuttalliana* 126, 187, 188,
208
- Muhlenbergia diffusa* 82
- glomerata* [142], [147], 161, 174
- gracilis* 187
- gracillima* 271, 275
- mexicana* 45, 142, [147]
- Porteri* [240]
- racemosa* 17, 45, 187, 200
- tenuiflora* 100
- Myosotis palustris* 81, 83, 100, 154,
162, 168
- Myrica cerifera* 100, 134, 178, 179,
180, 197, 246, 248
- Napaea dioica* 6, 17, 25, 32, 63, 81,
82, 83, 87, 98, 99, 100, 101, 121,
122, 123, 161, 168, 187, 241
- Naumburgia thyrsoflora* 76
- Notholcus lanatus* 252
- Nothoscordium bivalve* (*N. striatum*)
263, 264, 265

- Oenanthe aquatica* 90
californica 90
Onagra biennis (*Oenothera biennis*)
 6, 11, 19, 20, 21, 22, 27, 28, 32,
 52, 61, 66, 77, 85, 86, 94, 124, 145,
 153, 158, 173, 184, 185, 199, 208,
 218, 234
pallida 207
Onosmodium hispidissimum 180
occidentale 179, 232
Orchis spectabilis 178
Ornithogalum bivalve 263
umbellatum 263
Oryzopsis cuspidata 101
Oxalis Bowiei 68
corniculata 68
cymosa 17, 18, 32, 59, 61, 68, 78
Ortigiesi 68
violacea 46
Oxygraphis Cymbalaria 137, 147, 208,
 218
Oxypolis rigidus 89, 106
Oxytropis Lambertii 192
Panicularia americana 18
Panicum capillare 11, 18, 32, 63, 82,
 100, 121, 224, 251, 276
virgatum 50, 60, 64, 67, 77, 105,
 114, 123, 155, 181, 224, 269
Parthenium integrifolium 82, 92
Pastinaca sativa 89
Pentstemon alpinus 186, 200
barbatus 186
hirsutus (*P. pubescens*) 5, 6, 32, 33,
 39, 42, 67, 87, 94, 122, 123, 186,
 200
Petalostemon purpureus 154, 155, 168,
 179, 180, 181
Phacelia bipinnatifida 101, 122, 154,
 155
heterophylla 179, 232
tanacetifolia 223
Phalaris arundinacea 180, 278, 284
Phaseolus diversifolius 36
Philadelphus coronarius 216, 217,
 219, 237, 247
Keteleerii 237, 247
Phleum pratense 122
Phlox divaricata 17, 81, 181, 198
subulata 81
Phragmites communis (*P. Phrag-*
mites) 2, 26, 29, 104, 114, 160,
 174, 208, 218, 251, 294
Phryma leptostachya 99, 111, 115,
 178
Physalis heterophylla 32
pubescens 225
sp. 180
Physalodes Physalodes 17, 32
Picea canadensis 17, 277
mariana 195, 202
Pinus palustris 239, 248
rigida 46
taeda 198, 202, 211, 219, 238, 239,
 243, 248
virginiana 84, 94, 195, 202
Pisum sativum 182
Plantago aristata 24, 279, 284
eriopoda 24
lanceolata 23, 279, 284
Purshii 24
Rugelii 23, 28, 279
virginica 23, 24
Poa compressa 19
longiligula 101
Podophyllum peltatum 59, 61
Polemonium reptans 32, 45, 64, 65,
 76, 81, 82, 99, 101, 122, 156, 162,
 179, 181, 197, 198, 202, 261
Polygala Senega 45, 75, 76, 81, 82,
 83, 99, 101, 154, 155, 162, 181,
 182
Polygonatum biflorum 154, 278, 282,
 284
commutatum 180, 278, 282, 284
Polygonum amphibium 82
aviculare 268, 273, 275
emersum 18, 31, 53, 61, 69, 78
pennsylvanicum 18
scandens 81
virginianum 18
Polymnia canadensis 82, 92, 101
Populus angulata 36
angustifolia 36
balsamifera 36
canadensis 36
deltoides 17, 35, 36, 42, 46, 60, 64,
 77
grandidentata 36

- Medusae* 36
monilifera 36
tremuloides 36, 47, 60, 133, 147,
 198, 202, 212, 219
trichocarpa 36
Porteranthus stipulatus 117, 120, 144,
 145, 147, 157, 166, 175
Prunus americana 71
 Cerasus 71
 divaricata 70
 pumila 89, 94
 serotina 71, 78, 89, 94
 spinosa 70, 71
 virginiana 71
Pseudotsuga mucronata 198, 199, 202,
 212, 219
Psoralea Onobrychis 18, 64, 76, 81,
 99, 100, 101, 122, 162, 168
Ptelea trifoliata 6, 8, 22, 28, 50, 60,
 260, 265
Puccinellia airoides 137, 147, 208, 218
Pulicaria dysenterica 101, 155, 156
Pulsatilla hirsutissima 26
Pyrus communis 113, 131, 157, 194,
 217
 japonica 93
Quamasia hyacinthina 18
Quercus alba 84
 Phellos 239, 248
 rubra 195, 202, 238, 239, 248
 velutina 84, 94
Ranunculus abortivus 40, 42, 215, 295
 acris 252
 bulbosus 252
 cymbalaria 137, 292
 recurvatus 101
 scleratus 251, 252
 septentrionalis 26, 98, 155
Rhamnus alnifolia 180, 187, 200
 caroliniana 52, 61
 cathartica 52, 61, 180, 252
 lanceolata 52, 61
 Purshiana 252, 271, 275
Ribes aureum 17, 22, 32, 33, 37, 53,
 61, 65
 Cynosbati 11, 12, 18, 19, 20, 22, 32,
 33, 37, 38, 42, 53, 61, 86, 94, 99,
 102, 111, 113, 133, 178, 182, 199,
 212, 225, 237, 246, 254, 265, 269,
 270
 floridum 19, 20, 22, 33, 53, 103, 197,
 254
 gracile 12, 17, 19, 22, 65, 77, 86,
 94
 Grossularia 42
 longiflorum 254
 rotundifolium 53, 61, 66, 86, 94
 rubrum 53, 65, 86, 103, 133
 Uva-crispa 20, 22, 33, 42, 53, 61, 65
Roripa sinuata 49, 50
Rosa arkansana 47, 60, 106
 carolina 47, 60
 humilis 23, 28, 47, 60
 lucida 47
 nitida 47, 60
 pratincta 106, 114
 sp. 4
Rubus allegheniensis 207
Rudbeckia laciniata 63, 64, 65, 76, 81,
 82, 92, 120, 121, 142, 153, 178,
 181, 182, 197, 277, 279, 284
 triloba 63, 64, 178, 179, 180
Ruellia ciliosa 69, 70, 78, 294
 strepens 69, 70, 78, 224, 294
Rumex crispus 2, 104, 114, 160, 174,
 208, 218
 obtusifolius 2
Rynchospora alba 101
Salix amygdaloides 54, 56, 61
 Bigelowii 53, 55
 brachystachys 55
 discolor 17
 herbacea 56
 longifolia 5
 repens 56
 sp. 84, 94
Salsola Tragus 49, 50
Salvia lanceolata 36, 42
Sambucus canadensis 14, 19, 21, 22,
 28, 32, 52, 65, 77, 85, 94, 124, 146,
 158, 159
Sarcobatus vermiculatus 87, 104,
 126, 146, 208
Schedonnardus paniculatus 17, 100,
 122, 179, 207, 271, 275
Scirpus americanus 109, 115

- atrovirens 6, 12, 52, 61, 86, 94, 103,
 114, 125, 186, 200, 229, 247
 cyperinus 125, 146, 208, 218
 Eriophorum 230
 fluviatilis 89, 90, 94, 106, 114, 128,
 146, 242, 247, 253
 maritimus 90
 microcarpus 223, 230
 rubrotinctus 223, 230
 sylvaticus 223, 230
 Scolochloa festucacea 252
 Secale cereale 88, 127, 146, [257],
 265
 Senecio aureus 255, 256, 265
 calaliaefolius 255
 Douglasii (error for *S. spartioides*)
 ductoris 256
 lugens (error for *S. spartioides*)
 obovatus 17, 18, 32, 81, 82, 92, 99,
 101, 120, 121, 240
 palustre 255
 spartioides [178], [180], [189],
 [197], [200], [231], 247
 Sidalcea oregana 155, 179, 191, 207
 sp. 161
 Sieglingia seslerioides 6
 Silphium integrifolium 72, 78, 82, 88,
 92, 94
 laciniatum 93
 perfoliatum 32, 38, 65, 72, 82, 83,
 88, 92, 93, 94, 95, 101, 106, 109,
 114, 236
 terebinthinaceum 82, 88, 92, 94
 Sium cicutaefolium 90, 242, 247, 253
 latifolium 89
 Sisyrrinchium gramineum (*S. gramin-*
 oides) 128, 129, 146
 Sitanion elymoides 262
 longifolium 162, 163, 174, 187, 200
 Smilacina stellata 99, 282
 Smilax herbacea 26, 29, 81
 hispidula 26, 29, 33, 42, 67, 77, 100,
 104, 114, 121, 122, 127, 134, 135,
 147, 160, 173, 187, 200, 251
 rotundifolia 134, 135
 Solidago caesia 27, 29, 38, 42, 178
 canadensis 11, 14, 19, 20, 27, 29, 32,
 37, 38, 39, 42, 45, 66, 73, 77, 78,
 98, 99, 101, 102, 110, 111, 124,
 146, 153, 178, 182, 184, 188, 190,
 200, 224, 229, 231, 234, 238, 240,
 242, 243, 246, 247, 254, 264, 279
 flexicaulis 37, 42
 glaberrima 238, 246
 lanceolata 184
 missouriensis 238
 mollis 231, 238, 246
 nemoralis 184, 190
 rigida 18, 27, 29, 32, 38, 179
 rugosa 184, 190, 201, 238, 242, 246
 serotina 11, 20, 21, 27, 29, 37, 38,
 42
 trinervata 73, 78
 ulmifolia 27, 29, 46
 Sophia incisa (error for *S. brachy-*
 carpa) [49], [60], [68], [77]
 incisa (error for *S. intermedia*)
 [49], [50]
 Sorbus americana 90, 93, 95, 100,
 107, 112, 113, 114, 115, 130, 131,
 132, 146, 147, 157, 165, 166, 174,
 194, 201, 211, 219
 Aria 133
 aucuparia 133, 165, 174, 211, 217
 hybrida 133
 terminalis 133
 Spartina cynosuroides (partly for *S.*
 Michauxiana) [8], [31], [51],
 [60], [67], [75], [76], [77], [78],
 [83], [103], [106], [114], [127],
 [146], [156], [160], [164], [174],
 [181], 258, 265
 gracilis 154
 Michauxiana (partly under *S. cyno-*
 suroides) [8], [31], [51], [60],
 [67], [75], [76], [77], [78], [83],
 [103], [106], [114], [127], [146],
 [156], [160], [164], [174], 181,
 188, 198, 200, 202, 236, 247, 258,
 261, 265, 271, 275, 281, 283, 284
 patens 181
 polystachya 127, 146
 stricta 127, 146
 sp. 180
 Sphaeralcea incana 223, 240, 247
 lobata 223, 224, 241, 247

- Spiraea lobata* 5
stipulata 145
- Sporobolus asperifolius* 63, 179, 206, 240, 247
 cryptandrus (partly error for *Stipa viridula*) [109], [115], 223, 270, 275, 280
 heterolepis 18, 279, 284
 longifolius 7, 17, 22, 28, 50, 60, 67, 77, 225
 neglectus 32, 182, 274
 vaginaeflorus 273, 275, 280
- Stanleya pinnata* 50
- Steironema ciliatum* 46, 63, 65, 66, 76, 78, 83, 106, 114, 156, 157, 164, 174, 181, 198, 236, 261, 265, 267, 271, 275, 282, 283
 lanceolatum 76, 83, 156, 157, 164, 174, 236, 282
- Stenobium molle* 73
 stans 73, 78, 88, 94
- Stipa comata* 75, 231, 247
 spartea 18, 57, 61, 163, 188, 200
 viridula (partly under *Sporobolus cryptandrus*) 75, 78, [109], [115], 154, 163, 174, 213
 sp. 188, 200
- Strophostyles helvola* 36, 42
- Stylophorum diphyllum* 17
- Symphoricarpos oerophilus* 197
 parviflorus 168
 pauciflorus 45, 153, 154, 179
 racemosus 17, 18, 32, 45, 63, 98, 99, 100, 101, 122, 154, 155, 179, 180, 181, 189, 196, 202
- Syringa vulgaris* 51
- Taraxacum Taraxacum* 13
- Tecoma mollis* 73
 radicans 73
 stans 73
- Thalictrum alpinum* 154, 161, 174, 232
 dioicum 64, 76, 81, 82, 99, 122, 127, 139, 140, 147, 154, 161, 168, 178, 233, 242, 256, 265
 Fendleri 140, 223, 232, 242, 256
 occidentale 140
 polygamum 101, 122, 179
 purpurascens 154
 sparsiflorum 139, 140
 venulosum 140
- Tissa canadensis* 180, 181, 188, 190, 209
- Tithymalis arkansanus coloradensis* 154
- Tridens flavus (Tricuspis sesterioides, Triodia cuprea)* 6, 22, 28, 50, 60, 259, 265
- Trifolium carolinianum* 244, 248
 medium 193, 210
 pratense 182, 193, 210
 repens 193, 210
- Trillium cernuum* 180, 278
 recurvatum 37, 81, 82, 98, 282
- Triosteum perfoliatum* 81, 100, 101
- Tripsacum dactyloides* 18
- Trisetum majus* 180, 213, 219
 subspicatum 213, 214, 219, 234, 247
- Triticum vulgare* 19, 28, 88, 94, 162, 163, 174, 276
- Troximon glaucum* 136
- Tsuga canadensis* 91, 277
- Ulmaria rubra* 5
- Urtica gracilis* 11, 19, 22, 28, 52, 63, 66, 77, 103, 109, 113, 134, 158, 159, 173, 186, 197, 200, 269, 270
- Uvularia grandiflora* 179, 180, 278, 280, 282
 perfoliata 45
- Vaccinium pennsylvanicum* 166, 175
- Vitis-idaea* 167
- Vagnera racemosa* 278, 282
 stellata 180, 225, 278, 280, 281, 282, 284
- Verbena stricta* 7, 17, 22, 28
 urticifolia 18, 22, 28, 50, 60, 67, 77, 122
- Vernonia arkansana* 121
 crinita 198, 202
 fasciculata 239, 243, 248
 gigantea 211, 219
 sp. 274, 275
- Viola cucullata* 11, 32, 37, 81, 99, 100, 101, 120, 123, 155, 163, 174, 230, 247
 Nuttallii 230, 247

papilionacea 63, 76
 pubescens 82
 primulaefolia 164, 230
 septentrionalis 180
 sororia 154
 striata 98, 99, 231
 Viorna Douglasii 180
 Scottii 105, 114

Xanthium canadense 11, 14, 17, 18,
 19, 22, 32, 46, 71, 74, 78, 236
 sp. 88, 94
 Xanthoxylum americanum 18, 32, 50,
 63, 100, 142, 168, 179, 206, 207,
 225
 Zea Mays 18, [59], 61, 68, 69, 78

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